



Spectrum leasing in the 5G era

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Executive summary



Spectrum leasing can take different approaches, while regulation varies considerably

With spectrum leasing, licensed bands that have already been assigned to an organisation (such as a mobile operator) on an exclusive basis can be rented by another user, typically for a limited period of time and/or for a portion of the spectrum included in the licence. Examples include leasing spectrum to wireless internet service providers in rural areas or leasing to support localised private networks for use by industry verticals.

Our mapping of the regulatory landscape points to significant variation in where spectrum leasing is and is not allowed, both within and between regions. For instance, leasing is a key secondary spectrum market initiative in the US, but it is not currently permitted in certain European markets and in most markets in Asia, Latin America, Africa and the Middle East.

Success to date suggests untapped potential

There is considerable variation globally in the extent to which spectrum leasing has taken root. Despite consensus among operators that voluntary leasing should be permitted, demand has not been universally strong where licences have allowed leasing. However, there are some examples that appear to have yielded positive market outcomes in terms of delivering additional coverage and strengthening services for consumers. These have tended to originate from higher income markets, such as the US and Europe. In other regions (e.g. Sub-Saharan Africa), insufficient spectrum availability is cited as a major impediment to leasing. Leases have often been agreed on a regional or local basis where operators are not using their spectrum holdings to full capacity (specifically, certain bands).

The opportunity for spectrum leasing could expand in the 5G era

A primary motivation for spectrum leasing is the potential commercial benefit to lessors in terms of revenue generation and cost savings of leasing unutilised frequencies for certain uses or periods. Leasing can provide a flexible opportunity to meet the specific spectrum demands of industrial or enterprise customers, rural telecoms providers or other mobile operators.

Some policymakers also recognise the value of leasing, considering it a means of ensuring efficient use of spectrum resources. By facilitating leasing, regulators can avoid setting aside spectrum for a particular use as a mutually exclusive choice. They can continue to award licences, thereby ensuring that spectrum is efficiently used, but also allow for alternative users to access and use spectrum in specific geographical areas or over certain periods.

As 5G develops and deployments progress, spectrum leasing could become more attractive and widespread for several reasons, including spectrum supply (e.g. greater availability in mid and high bands), and demand from different users that may want access to spectrum to provide the necessary local capability to realise an unaddressed business opportunity or to establish dedicated networks for industries.

Users face numerous challenges to engaging in leasing

There are several challenges to successfully implementing spectrum leasing more widely. Some could be within the scope of operators to overcome; others appear beyond their direct or sole control. Issues include the following:

- Regulatory barriers: from outright prohibitions on spectrum leasing to the lack of a clear framework that allows leasing or governs aspects of the process.
- Technical challenges: the feasibility of leasing can be impacted by coordination or interference issues, and is dependent on how much spectrum has been brought to market to support the deployment of advanced mobile technologies.
- The commercial opportunity: the costs of providing leasing services (for example, network set-up and integration) can be seen to outweigh relatively small revenues from low demand, making for an unattractive business case.

Enabling factors can help overcome the barriers

The potential enabling factors to capitalise on the spectrum leasing opportunity somewhat mirror the identified challenges. Firstly, the removal of barriers that have prevented or even forbidden leasing occurring to date means mobile operators can make spectrum across different bands accessible to other users, including competitors, for a given period of time and/or in a defined area. In addition, guaranteeing spectrum supply and licence renewal (while foregoing set-asides) can help to create a liquid secondary market for leasing, which can be supported by allowing voluntary and commercial negotiation between parties to establish leasing agreements.

Policymakers and operators can help realise the potential of leasing

Despite the challenges, there is a clear market opportunity for spectrum leasing, with potential benefits irrespective of the type of lessee. To mitigate the risks and accentuate the benefits of leasing, policymakers and operators can take a number of steps.

Regulators should consider how they put in place the frameworks to facilitate leasing, which should be underpinned in the first instance by market negotiation rather than regulation and supported by sufficient supply of spectrum.

Operators and other market players should consider how they organise internal resources, including collaboration between network and commercial departments, in order to identify situations where they can engage in the secondary access market and realise the business opportunity that spectrum leasing presents.

1. Spectrum access methods and authorisation regimes



Access to spectrum is controlled at the country level, typically by a national regulatory authority (NRA), and managed through different authorisation regimes, which can be classified into three main categories:

- licence-exempt access
- light licensing
- licensed access.

Licence-exempt access

Licence-exempt access, also known as unlicensed or general authorisation, allows the use of radio devices without individual authorisation. This type of spectrum access is suitable for radio services and devices that have self-containable interference potential, as the spectrum is open for use by many different users. These include short-range devices and amateur radio. Nevertheless, some conditions need to be imposed on unlicensed spectrum use – for example, limits on the maximum power of devices to help manage interference, adherence to co-existence protocol requirements, compliance with out-of-band (OOB) limits, and the use of “listen before talk”¹ (often defined in the equipment standard).

¹ Listen before talk (LBT), sometimes called listen before transmit, is a technique used in radiocommunications whereby a radio transmitter first senses its radio environment before it starts a transmission. LBT can be used by a radio device to find a network on which the device is allowed to operate or to find a free radio channel on which to operate.

Light licensing

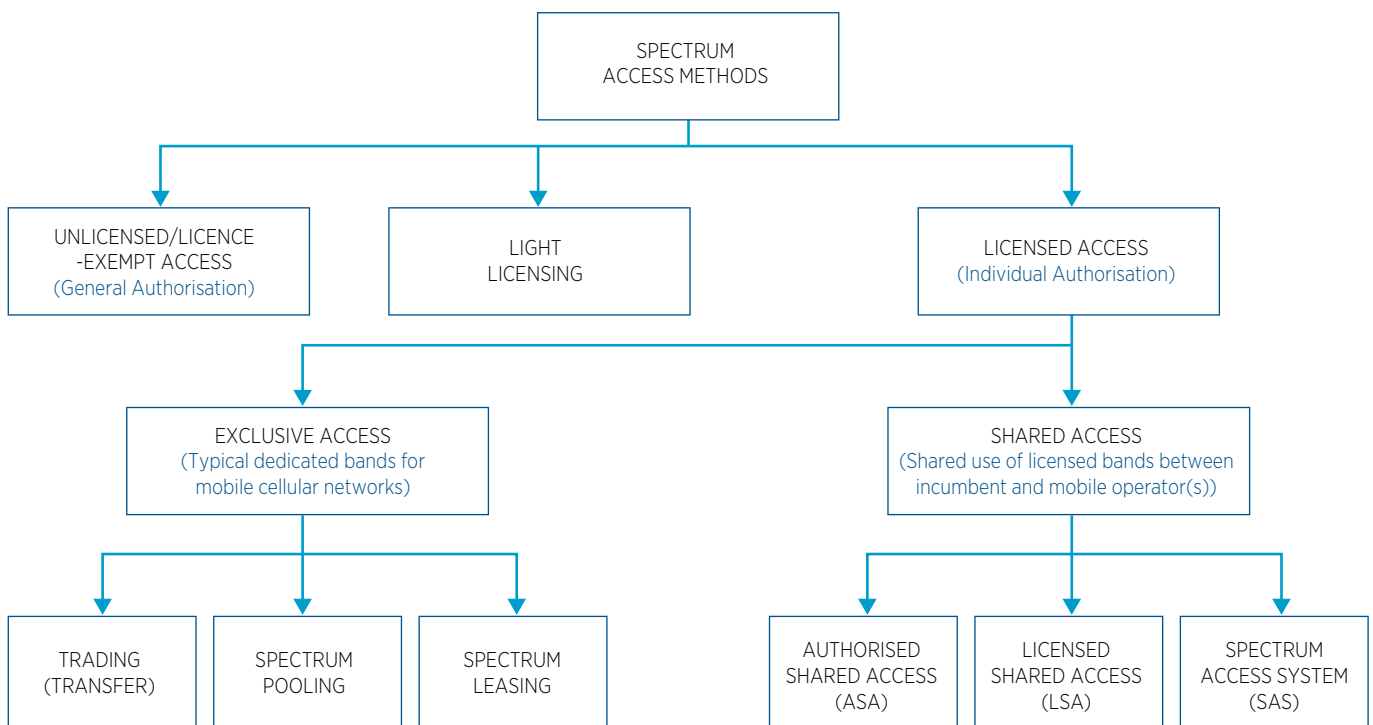
The light licensing regime represents a flexible and simplified regulatory framework of issuing spectrum authorisations, providing a middle ground between exclusive licensing and unlicensed use. The approach is generally applied for spectrum where there is no excess demand. Light licensing does require a licence, but it is typically at very low cost and available on request to anyone. Licensees prefer to have a licence for clarity over their rights in the area and the frequency in which they will operate.

Light licensing does not attempt to control interference through technical licence terms; instead, it relies on resolving any interference if and when it occurs. There are typically some generic conditions where licensees have to register their use of spectrum in some way (e.g. a database) including transmitter location(s) and power levels.

This type of licensing comes with quality-of-service (QoS) concerns for mobile access and is typically used in wired/wireless service links (i.e. backhaul) or mmWave antenna technologies. This is because the propagation characteristics facilitate operation with minimum risk of interference.

FIGURE 1

SPECTRUM ACCESS METHODS



Source: GSMA Intelligence

Licensed access

With this type of authorisation, the right of access to spectrum is granted on an individual basis. Only the licence holder is authorised to use the specific frequency band. Under this authorisation regime, there can be different levels of access and sharing schemes of licensed bands.

Exclusive access

With dedicated access to the licensed frequency bands, the licence holder with this type of authorisation has exclusive use of the spectrum. The advantage of this licensing method is that there are no other systems operating within the frequency band and therefore no interference, meaning QoS requirements are guaranteed.

Access to spectrum can also be enabled through a secondary market. More generally, secondary markets are common in many sectors of the economy. In the case of spectrum access, the concept is realised through spectrum trading and leasing, in which licence holders are allowed to trade (licence resale) or lease (partial or temporary transfer of usage rights) their licences or assigned spectrum usage rights to other users.

Practical experience of spectrum trading generally and leasing in particular has so far been limited to a handful of countries. In some countries, spectrum usage rights can be constrained by other restrictions, such as regulatory approval, technology permitted, geographical area, time of use and technical conditions.

There is often misuse of terms for secondary market transactions. For instance, spectrum leasing is sometimes interchangeably used with spectrum trading and/or spectrum transfer. Although leasing can be seen as closely linked to trading and spectrum transfers, for clarity the following definitions of terms can be referred to:

- Spectrum trading

With spectrum trading, spectrum usage rights are exchanged in return for a financial settlement for the full duration of a licence or remaining term. This transaction can involve either all the frequencies or geographic coverage of the licence or a subsection. In other words, spectrum trading represents the transfer of spectrum usage rights as opposed to the sale of a company, including its spectrum usage rights.

- Spectrum pooling

Spectrum pooling involves multiple spectrum users combining some or all of their spectrum assets and coordinating use to avoid interference. In practice, spectrum pooling is typically an extension of active infrastructure sharing. Although most network sharing deals today only involve sharing radio access network (RAN) components, spectrum pooling is possible with more extensive active sharing, which can include sharing core network elements. With greenfield deployments, users may choose to split the country geographically and assume responsibility for rolling out the shared network in different areas. With non-geographical separation, capacity is split on the network, as stated in the sharing agreement.

This model can be implemented in different ways, but a single joint venture (JV) often runs the network – with the separate operators becoming ‘customers’ of that company. The operators would have roaming-type agreements in the areas covered by the JV, while using their own network infrastructure in other areas. In most cases, the most densely populated areas will not be covered by the JV; this model tends to be used mostly in rural areas. For example, infrastructure with spectrum sharing (spectrum pooling) has been permitted in Sweden since the early 2000s, with several bilateral sharing agreements in place between operators in the country: Telia and Tele2; Telenor and Tele2; and 3 (Hutchison) and Telenor.

- Spectrum leasing

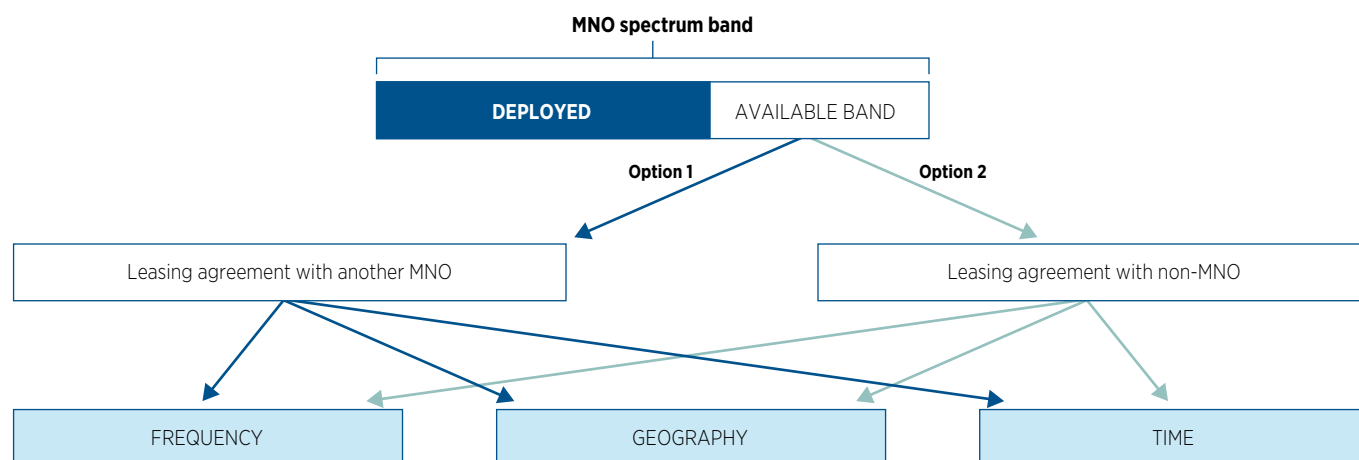
In this access model, licensed bands that have already been assigned to an organisation on an exclusive basis can be rented by another user. Spectrum leasing typically involves a partial transfer of a licensee’s rights to spectrum to another user for a limited period and/or for a portion of the spectrum included in the licence. There are different models or approaches to spectrum leasing:

- Lessee-controlled leasing: the lessee (the party taking control of the spectrum from the licence holder) takes responsibility for all the rights and obligations associated with the licence. The lessee has legal and de facto control of the spectrum for the period covered by the lease.
- Lessor-controlled leasing: the original licence holder retains legal and de facto control of the spectrum but allows another party (the lessee) to use it. The lessor is responsible for the terms and obligations of the licence.

Spectrum leasing (as well as other secondary market transactions) is often subject to regulatory approval. In general, stakeholders taking part in such transactions can be mobile operators or other companies that have a spectrum licence on one side, and a party such as another mobile operator or other entity requiring access to spectrum on the other side.

FIGURE 2

SPECTRUM LEASING IN PRACTICE



Source: GSMA Intelligence

Shared access

With a shared access authorisation regime, spectrum is shared but only by authorised users and subject to strict requirements. There are multiple sharing schemes: authorised shared access (ASA), licensed shared access (LSA) and spectrum access system (SAS). LSA and ASA were developed to allow spectrum to be licensed for international mobile telecommunications (IMT), while ensuring continuation of the incumbent use in the same spectrum band. Theoretically, this would increase the use of the radio spectrum by allowing 'shared access' where and when the primary licensee is not using its designated frequencies.

- Authorised shared access

This access method was introduced to open up additional frequency bands currently not allocated for mobile broadband, as an alternative to spectrum clearing/refarming. The model was developed initially for the 2.3 GHz band (in the UK) and then the 3.5 GHz band (in the US) on a shared, non-interference basis for mobile services.

- Licensed shared access

LSA is an extension of the ASA concept. Under this model, the incumbent licence holders can sub-license spectrum to other users in a controlled way, under certain rules and on a non-interference basis. This therefore allows continued use of spectrum for the incumbent, while providing potential use of the same spectrum for other users. Sharing under the LSA framework is binary by nature, as it allows spectrum use by either the incumbent or the LSA licensee. Such users could potentially provide other applications or radio services. The LSA model has two tiers, the incumbent and secondary users, who are permitted to use the spectrum in areas and at times available. The LSA concept is extended to support different types of spectrum users.

- Spectrum access system

Similar to LSA, the SAS concept identifies a three-tier system. This has been defined by the FCC in the US and currently targets the 3.55–3.7 GHz band, also known as CBRS. The first tier, as with the LSA framework, is the incumbent user. The second tier, called priority access licence (PAL), is for another user, which can be a mobile operator. In contrast to LSA, a third tier called general authorised access (GAA) is defined, providing lower access guarantees than PAL. The level of interference protection between the tiers is reduced top-down.

2. The regulatory landscape



'Based on research and industry engagement, Figure 3 below illustrates the regulatory status of spectrum leasing at the national level, with Table 1 then providing further details on the regulation in certain markets or regions.'

FIGURE 3

MAPPING THE SPECTRUM LEASING LANDSCAPE

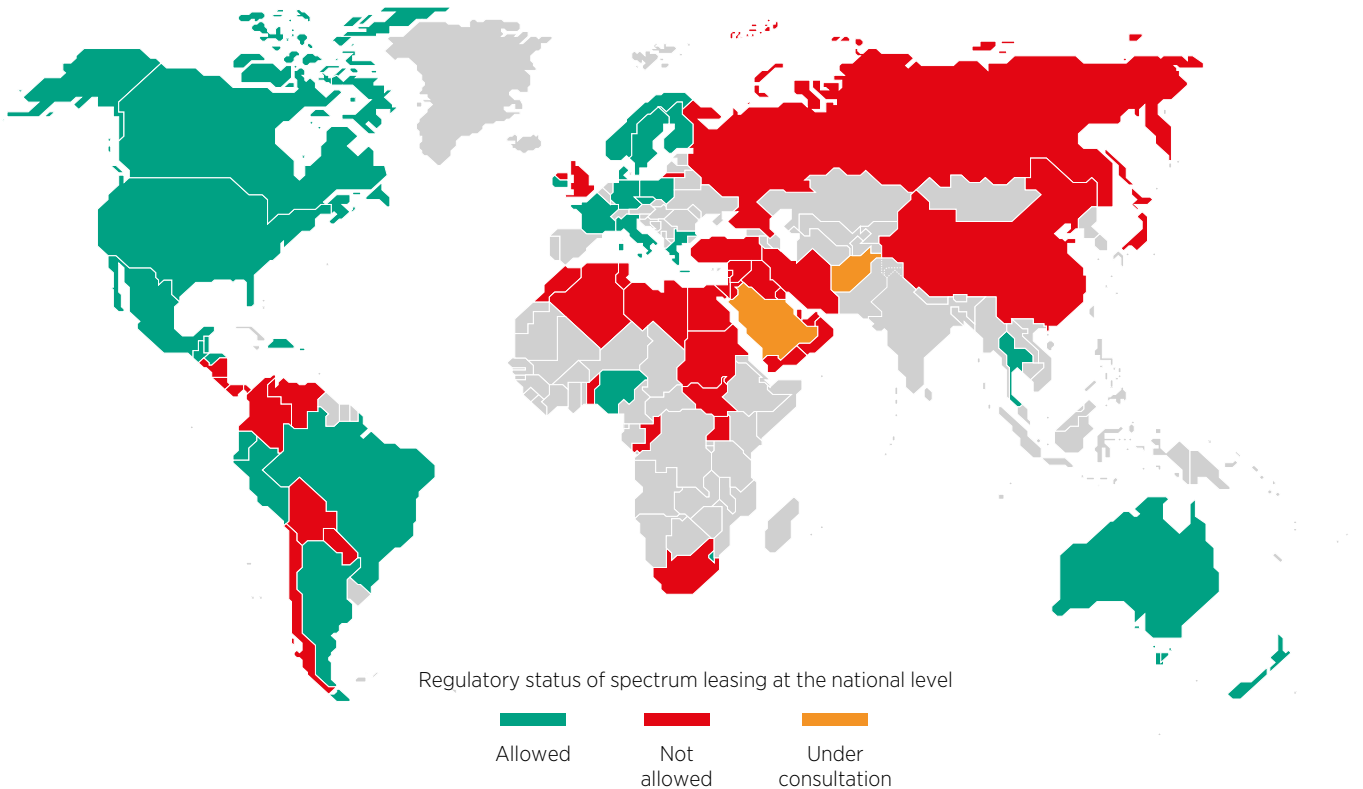


TABLE 1

EXAMPLES OF SPECTRUM LEASING REGULATION

Market/region	Position
EU	In its decision on the use of the 700 MHz band, the EU determined that member states should allow the transfer or leasing of such rights in accordance with open and transparent procedures pursuant to the applicable Union law. ² The EEC supports “the entry of new spectrum users and economic operators through increased recourse to shared use of radio spectrum and general authorisation where possible, as well as easier spectrum trading and leasing”. ³ Further, the Radio Spectrum Policy Programme (RSPP) in principle allows trading and leasing in the EU.
Finland	In an effort to avoid set-asides for new entrants in a key 5G band, the regulator attached an obligation to mobile operators’ licences in the 3.5 GHz spectrum band to either participate in tenders for vertical contracts in localised areas or else sub-license spectrum to the vertical so they can build their own network where they have not been able to provide suitable services. ⁴
France	Arcep imposed sharing/leasing on spectrum in the 3.5 GHz band to cater for vertical needs, requesting that through licence obligations operators “commit to granting reasonable requests from vertical industry companies, by providing them with customised solutions in terms of coverage and performance or, if the operator prefers, by assigning its frequencies locally to verticals”. ⁵
Denmark	In the 3.5 GHz band, a leasing obligation for the purpose of establishing private networks is attached to the upper 60 MHz of the band (3740–3800 MHz). The rental obligation gives actors other than mobile operators, such as enterprises, public institutions and universities, the right to lease frequencies from the current licensee (TT-Network) for the purpose of establishing private 5G networks. The rental obligation applies for the first four years of the permit period. A company or public institution must within this period have contacted TT-Network and expressed interest in renting frequencies for the establishment of a private network. However, the company or public institution in question has the option of renting the frequencies throughout the permit period (i.e. until 2041). ⁶
UK	Spectrum leasing is available only to certain classes of licence (business radio and spectrum access), and a licence variation is required in order to grant permission for leasing to be offered. ⁷ Ofcom has not extended leasing to a broader set of licences (including mobile) because of a general lack of demand and because it believes there are elements of the process that are unattractive. However, Ofcom is keeping this position under review and would consider extending leasing if it thinks there are likely to be net benefits, including sufficient evidence of demand to lease spectrum. ⁸
Japan	Essentially there is no such concept as spectrum leasing, given the manner in which spectrum assignments are seen as rights for operators to use the spectrum. This is unlikely to change in the future.
Ecuador	Spectrum leasing is possible with prior authorisation from the NRA. However, transferring the regulatory obligations (e.g. interference) is not permitted; these have to be retained by the licence holder.
Venezuela	The licences impose a set of duties and rights and do not allow for re-assignment or transfer, neither totally nor partially to third parties. Although leasing as such is not mentioned, it can be regarded as a sub-group of transfer.
Colombia	The legislation provides that the spectrum can be transferred with prior authorisation from the Ministry. However, reversion to the original holder is not foreseen. This therefore indicates that leasing is not permitted.
Paraguay	The law states that the total transfer of the licence to which the assignment of frequencies is tied is allowed with prior authorisation from the regulator. However, the transfer implies that the right of use of frequencies is lost, implying spectrum leasing is not allowed.
Other Latin American countries	Within the region, spectrum leasing is allowed in several countries, while in others there is no such concept. In certain countries, even if leasing is stipulated in the Telecommunication Law, it is still subject to approval from the NRA.
MENA	Spectrum leasing is not currently permitted in any country in the region. There is an ongoing spectrum trading and secondary market public consultation in Saudi Arabia.
US	Spectrum leasing is part of the FCC’s secondary market initiatives designed to remove regulatory barriers and increase access to spectrum. Licensees that hold “exclusive use” licences can lease spectrum to third parties using two arrangements: spectrum manager leasing and de facto transfer leasing. ⁹ For some bands, build-out requirements are imposed that require licensees to use it or lease it.
Canada	When a licence for a specific band is awarded to a service provider, the licence is exclusive. Licence holders may trade, lease or sell their allocations, but the arrangements must comply with the original auction conditions and must be approved in writing by ISED Canada.

Source: GSMA Intelligence

2 <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017D0899&rid=2>

3 <http://5gobservatory.eu/observatory-overview/observatory-reports/>

4 5G Spectrum: GSMA Public Policy Position, GSMA, 2021

5 “Allocation of 3.4 - 3.8 GHz band frequencies: Arcep publishes its allocation procedure and applicant obligations for public consultation”, Arcep, July 2019

6 In the longer term, the Danish Energy Agency will work to make frequencies for private networks available in the neighbouring frequency band (3.8–4.2 GHz). 400 MHz in the 26 GHz frequency band has also been dedicated to private networks.

7 Supporting the UK’s wireless future: Our spectrum management strategy for the 2020s, Ofcom, 2021

8 Award of the 700 MHz and 3.6–3.8 GHz spectrum bands: Annexes 5–18 – supporting information, Ofcom, 2020

9 <https://www.fcc.gov/spectrum-leasing>

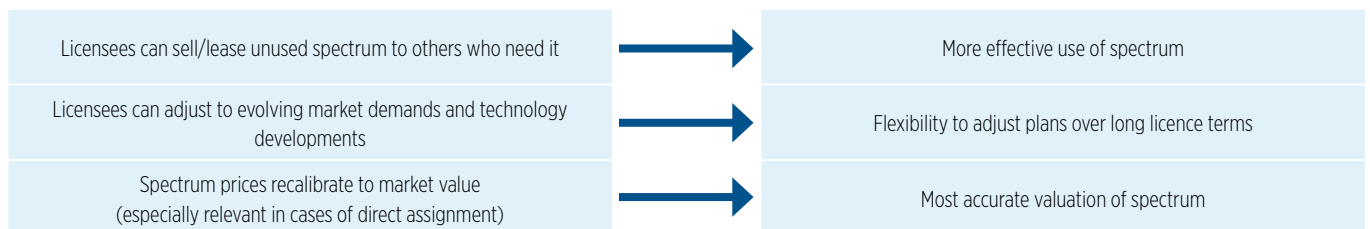
3. The opportunity



According to the Digital Regulation Platform (a joint effort by the International Telecommunication Union and World Bank), establishing a secondary market for spectrum trading and allowing spectrum leasing provides many benefits. See Figure 4.

FIGURE 4

SPECTRUM TRADING OR LEASING IN SECONDARY MARKETS



Source: Digital Regulation Platform¹⁰

GSMA research suggests that although it is dependent on local market conditions and regulations, spectrum leasing can represent a viable proposition for operators and certain third-party verticals.¹¹ The potential value of spectrum leasing can be financial or non-financial, as well as enabling efficient use of spectrum.

¹⁰ <https://digitalregulation.org/spectrum-pricing-and-trading/>

¹¹ Mobile Networks for Industry Verticals: Spectrum Best Practice GSMA Public Policy Position, GSMA, 2021

3.1 Motivations for lessors and lessees

A primary motivation for spectrum leasing is the potential commercial benefit to lessors in terms of revenue generation and cost savings from leasing unutilised frequencies for certain uses or periods. It can provide a flexible opportunity to meet the specific spectrum demands of industrial or enterprise customers, rural telecoms providers or other mobile operators. It is also generally simpler to achieve than trading, which typically requires the regulator's involvement. There can be a positive business case for leasing in the following scenarios:

- **Temporary:** Operators could lease spectrum for alternative uses, such as short-term interference testing, programme making or live events where this does not cause undue interference to the provision of other services. For example, Telefónica's timebound lease of 2.6 GHz spectrum to 1&1 Drillisch has allowed the lessee to convert its capacity-based MVNO contract into a capacity-based agreement for national roaming – an important step as it builds a 5G network.
- **Local:** Spectrum leasing can be a viable option for supporting enterprise verticals that want to build private networks. In some markets, regulators already permit, indeed encourage, mobile operators to lease their spectrum assets to non-operators for local business applications, which can accelerate new services and stimulate competition. Spectrum could also be leased to other operators in a defined local area. According to StrattoOpencell, its use of spectrum underused by mobile operators in rural areas allows for “better service to end users, lower costs to customers and asset optimisation” for the lessor.

- **Regional:** If a national licensee is not using its spectrum in a particular geography within a reasonable period of time, it could be sub-leased to other market players, including competitors. In Italy, TIM has leased 3.4–3.6 GHz spectrum to a fixed wireless access (FWA) operator on a regional basis.

Leasing can also be a positive spectrum management tool for regulators that preserves the benefits of market-based awards, and avoids potentially harmful measures such as set-asides. While reserving spectrum for local or vertical use in priority 5G bands (i.e. 3.5/26/28 GHz) could jeopardise the success of public 5G services, leasing can provide verticals with access to spectrum while mitigating the risk of inefficient spectrum use. Leasing can therefore be a means of maximising the benefits of exclusively licensed spectrum, especially where frequencies go unused/underutilised or there is spare capacity (for example, smaller operators with larger holdings relative to the size of their subscriber base). Leasing can ensure spectrum continues to be efficiently used and available to meet the needs of potential users over time, as market and technology conditions go through iterations of change.

Estimating the economic opportunity of spectrum leasing

Spectrum leasing can drive private economic benefits to businesses. Most importantly though, it can be an effective and efficient way for public policymakers and regulators to manage spectrum, helping maximise the economic benefits to society.

Private benefits from spectrum leasing can be reaped by mobile operators when they obtain an additional financial return from their spectrum holdings. Leasing can also help achieve benefits other than financial returns. For example, in the US, where leasing is permitted, mobile operators can achieve their rollout coverage obligations by leasing spectrum to third parties planning to use the leased spectrum to roll out networks in uncovered areas.

Spectrum leasing by operators can also play an important role in meeting the needs of local enterprise users, by permitting innovative services that require local access to spectrum to deploy services more quickly and flexibly than by obtaining spectrum from the regulator. This flexibility (in terms of contract length and geographical coverage, for example) is particularly important for vertical applications and local uses experiencing rapid technological change and/or in the early phases of business development.

Most regulators are also concerned with the **public or societal benefits** that can be achieved through spectrum leasing. The main question faced by policymakers is whether spectrum leasing can result in more efficient use of radio spectrum than alternative approaches and should therefore be promoted.

A good way to help answer this question is to take the case of how best to enable 5G private networks in vertical industries. Some countries, such as Germany, have set aside spectrum for local use licences. An argument in favour of setting aside spectrum for vertical use is to ensure the availability of spectrum to support enterprise use cases via private or dedicated networks. However, it has also been argued that these benefits could be achieved under alternative policies that do not require set-asides of spectrum, such as spectrum leasing or sharing.¹²

If spectrum demand from local users can be guaranteed under both approaches, it is clear that spectrum set-asides for local verticals achieve the same objective (of letting a vertical access spectrum) but at a much higher cost to society. Conservative estimates based on the German 5G auction indicate that €1–1.5 billion of private value was lost due to the reservation of 100 MHz of mid-band spectrum for local use, driving a consumer harm of €6–15 billion.¹³ With spectrum leasing, none of this lost value would have materialised.

Spectrum leasing can help maximise spectrum use without departing from market-based mechanisms, which could lead to inefficient spectrum use to the detriment of society as a whole. More generally, spectrum set-asides can be seen as a form of ex-ante regulation, where remedies are deployed before a market failure has even occurred. Ex-ante regulations can sometimes be justified where extreme and socially unacceptable costs can occur if a market failure materialises (e.g. pharmaceutical drug safety approvals).

As illustrated in the case of Germany, spectrum leasing can avoid the high societal costs of departing from a market-based mechanism. Even if market failures materialise in the future (for example, if there are instances where verticals cannot access spectrum because spectrum leasing markets have not developed quickly enough), ex-post regulation could in such a case be considered by regulators without incurring any of the initial societal costs.

¹² 5G IoT Private & Dedicated Networks for Industry 4.0, GSMA, 2020

¹³ "An industrial 5G Spectrum Policy for Europe", Vodafone, November 2019

3.2 Motivations for policymakers

Some policymakers also recognise the value of spectrum leasing. By facilitating leasing, regulators can avoid setting aside spectrum for a particular use as a mutually exclusive choice. They can continue to award licences, thereby ensuring that the spectrum is efficiently used, but also allow for alternative users to access and use spectrum in specific geographical areas or time periods. For example, in the Netherlands, the new Dutch Telecommunications Act (which will transpose the European Electronic Communications Code, or EECC) will expand the opportunity for operators to lease spectrum (i.e. “frequencies for mobile-data traffic”), reflecting the desire expressed by market participants to engage in this practice.¹⁴ Until the transposition of the EECC, telecoms sector legislation did not allow for this, with the use of licensed spectrum only possible for the licence holder.

The Netherlands Authority for Consumers and Markets (ACM) considers that leasing makes it possible to use spectrum in a flexible manner, with the potential for more efficient use of spectrum. It sees two types of agreement: leasing between mobile operators, and leasing between an operator and non-operator:

- The ACM expects that operators will only have an incentive to rent out spectrum to a rival if it does not jeopardise their own services and competitive position. A possible example is a short-term lease agreement whereby an operator rents out its unused spectrum to a competitor for interference tests in a remote area. Further examples include live events or using spectrum for temporary use locally.
- The ACM expects that leasing to non-operators will only relate to a small share of the frequencies licensed to an operator and is likely to be local in nature, based on the needs of businesses and residents in places where fixed or mobile services from the national providers are not sufficiently available. Possible examples include offering broadband services in remote areas using a 4G connection, or a business-specific application in a business park.

The ACM is of the opinion that, in many situations involving leasing between mobile operators, spectrum caps (the maximum volume of bandwidth that an operator can use with its own and leased spectrum) prevent competition from being distorted. With regard to renting out spectrum by operators to non-mobile network operators (such as local network operators or private network operators), the ACM does not see any reason in advance for considering such arrangements as anticompetitive, while they could lead to new services and increased competition.¹⁵

Irish communications regulator ComReg has determined that secondary markets could play a role in ensuring efficient assignment and use of spectrum in some areas. During the Covid-19 pandemic, the criticality of connectivity was brought to the fore, with the internet acting as a gateway to remote working, education, entertainment and communication. ComReg therefore asked mobile operators to consider relaxing data caps for customers and leasing spectrum to other operators.¹⁶ During 2020, ComReg received requests from Dense Air Limited and Ireland’s mobile network operators to lease spectrum rights on the 3.6 GHz band to Imagine Communications Ireland Limited, which operates a fixed wireless network but does not provide mobile services. With Imagine’s fixed wireless network experiencing an increase in peak data traffic higher than that of mobile networks, the regulator determined to grant the leases, allowing Imagine to make use of unused spectrum assignments in the 3.6 GHz band.

¹⁴ “ACM: telecom operators are allowed to work together for a fast roll-out of mobile networks”, ACM, February 2021

¹⁵ Guidelines for sharing of mobile networks, ACM, 2021

¹⁶ “Ireland assigns temporary spectrum as the profile of mobile data traffic undergoes a tectonic shift”, Alpha Wireless, April 2020

3.3 Success to date

Against a backdrop of different regulatory frameworks, there is considerable variation between markets in the extent to which spectrum leasing has taken root. Despite consensus among operators that voluntary leasing should be permitted, demand has not been universally strong where licences have allowed leasing. Where there has been demand, it has not always been possible to fulfil requests. A survey of Wireless Internet Service Providers Association (WISPA) members claims that spectrum leasing requests often fail to materialise, which indicates a number of barriers may be at play.¹⁷

There are, however, some examples which appear to have yielded positive market outcomes in terms of delivering additional coverage and strengthening services for consumers. These have tended to originate from higher income markets, such as the US and parts of Europe; in other regions (such as Sub-Saharan Africa), insufficient spectrum availability is cited as a major impediment to leasing. In Germany, Deutsche Telekom leased a 2×1.25 MHz channel in the 450 MHz band on a regional basis until the spectrum usage rights expired at the end of 2020. It has also leased part of its 2.1 GHz holding on a local and temporary basis to competitors or vendors in its domestic mobile market. As is typified by Deutsche Telekom's experience, leases have often been agreed on a regional or local basis where operators are not using their spectrum holdings – specifically, certain bands – to full capacity.

In May 2019, 3 Sweden signed an agreement to sub-lease 50 MHz of 2.6 GHz spectrum to specialist vertical micro-operator Edzcom (then known as Ukkoverkot) for use in private LTE networks.¹⁸ The deal, which was the first spectrum lease in the country intended to facilitate enterprise connectivity, is also designed to steer the regulator towards a new spectrum model, which encourages mobile operators to sub-license spectrum for specialist use, instead of intervening to allocate and subsidise spectrum for local industry.¹⁹

At least one spectrum lease has been a result of merger conditions: 1&1 Drillisch will lease 2×10 MHz in the 2.6 GHz band from Telefónica until the end of 2025, with the deal part of Telefónica's regulatory obligations arising from its acquisition of E-Plus in 2014.²⁰ Generally speaking, spectrum leases between mobile operators are fairly rare and are usually subject to competition assessments.

17 Comments to the FCC in the matter of promoting investment in the 3550–3700 MHz band, Dynamic Spectrum Alliance, 2018

18 "Three Sweden leases public spectrum for private usage to stop spectrum carve-up", Enterprise IoT Insights, May 2019

19 It is worth noting that in May 2021 the PTS opened a public consultation regarding the award of local 5G licences for industrial and public sector use in fields such as industry, mining, ports, warehousing and hospitals: <https://www.pts.se/en/news/radio/2021/consultation-regarding-conditions-for-local-5g-licences/>

20 "Telefónica Deutschland to lease spectrum to 1&1 Drillisch", Mobile Europe, December 2019



CASE STUDY

Vodafone, UK

Where full control over spectrum in mobile bands is a requirement for some industry uses, spectrum sub-leasing can play an important role. Vodafone considers that in circumstances where factories are located in areas where mobile operators are not making full use of a specific band, then it should be possible and desirable for them to sub-lease the spectrum.²¹

Vodafone UK has provided local sub-lease access to its (underused) national spectrum so that StrattoOpencell – now part of the Freshwave Group – could deploy 4G outdoor small cells in a coverage white-spot at a holiday site in Devon, UK and provide broadband services to all users in the locality.²² StrattoOpencell had to agree a three-year licence from Ofcom. Vodafone considers that the value proposition could be extended to other businesses in underserved rural areas, leveraging underused spectrum in these niche locales.

This is one of several examples across the UK. Others include the following:

- UK mobile operators, including Vodafone, have provided local access to national spectrum so that a rural community in Wiltshire can establish their own local village network.
- Vodafone is providing a 5G-ready mobile private network (MPN) for energy company Centrica, making local use of the operator's nationally licensed spectrum.
- Vodafone is implementing a 5G MPN for Ford's new facility in Essex for the manufacture of electric vehicle components.



²¹ An Industrial 5G Spectrum Policy for Europe, Vodafone, 2019

²² "Vodafone UK Share Unused 4G Spectrum for Rural Broadband", ISPreview, October 2019

3.4 Prominence in the 5G era

To encourage use of 3.4–3.8 GHz spectrum for 5G in Europe, the European Conference of Postal and Telecommunications Administrations (CEPT) issued guidance to national administrations, which included liberalising existing authorisations that expire beyond 2020 to allow them to be used

for 5G services and implement where needed trading and leasing across the band so that interested parties can acquire spectrum usage rights on a commercial basis.²³ While it is too early to say for some operators, several see spectrum leasing becoming more prominent in the 5G era for supply- and demand-side reasons.

TABLE 2

FACTORS THAT COULD INFLUENCE THE FUTURE OF SPECTRUM LEASING IN THE 5G ERA

Spectrum supply	More spectrum available overall (especially mid and high bands) could increase the opportunity and make leasing more feasible. However, where future supply of spectrum grows more slowly than demand, leasing options could become more attractive to ensure efficient spectrum use. Further, larger geographic licences of C-band spectrum in markets such as the US could make it uneconomical for utilities, verticals or enterprises to buy their own spectrum, which could therefore incentivise leasing.
Private networks	There is clear demand for 5G from manufacturers and port authorities, as well as smaller businesses, for industrial digitisation.
Technical capabilities	The advanced performance of 5G (particularly when using mmWave spectrum) allows for the emergence of new use cases and the deployment of network slicing for specific applications.
Cost-efficiency	With mobile operators facing significant financial and competitive challenges, leasing could provide a means to support rapid deployment of 5G, ²⁴ as well as an alternative to network densification, particularly for local uses.

Source: GSMA Intelligence

Whether interested parties move to lease out spectrum will largely come down to economics. Leasing is a less capital-intensive option but may not be as economically efficient over the long term (10+ years) as, for example, building a permanent national private network with spectrum owned by a mobile operator. This is particularly true for larger scale projects that can monetise the (mostly) fixed cost base against a higher range of productivity gains from having the private network in place. Ultimately both options are viable; it depends on the specific circumstances of an operator in a specific country.

Conversely, the rationale for leasing out spectrum from an operator perspective is likely to be strongest in areas where its own capacity load is low (rural or low market share regions), which may or may not be where enterprise demand arises. If operators lease in areas of full or near-full peak hour data traffic load, it could jeopardise service to their own customers.

The net result is that, even with 5G, leasing to enterprises is likely to be targeted based on the size of enterprise, expected payback period, willingness to take on high-tech projects, and regional differences in operator spectral capacity.

²³ ECC Report 287: Guidance on defragmentation of the frequency band 3400–3800 MHz, CEPT, 2018

²⁴ "T-Mobile strikes 600 MHz spectrum leases in 8 out of 10 top markets", Fierce Wireless, June 2020



4. The challenges

Although the factors outlined in Table 2 may signal greater prominence of spectrum leasing going forward, there are challenges to making it a success and more widely implemented. Mobile operators need to ensure any leasing agreement makes sense from a commercial and technical standpoint. Further barriers appear beyond operators' direct or sole control and may compound the commercial challenge of leasing for primary licence holders.

4.1 Regulatory barriers

A major barrier to spectrum leasing is the regulatory framework that governs the telecoms sector in a given market. In some markets, regulation prohibits the leasing of spectrum held nationally by mobile operators; in other markets, there is no clear regulatory framework that allows it or defines or oversees aspects of the process (for example, dispute resolutions). Unfavourable or restrictive licence terms and obligations disincentivise leasing and therefore efficient spectrum use. For instance, licence fees or obligations that are not transferable to the lessee (e.g. network coverage or site deployment) may discourage primary licence holders from engaging in this space as they would remain liable for any breaches of terms, and subject to additional responsibilities.

Perceived risks from competition bodies or such authorities' involvement in contract negotiations can also be a demotivating factor that threatens leasing's potential. In the UK, Ofcom has considered that leasing may raise competition issues as it is not involved in the leasing arrangement and hence has no opportunity to assess the impact on competition. In the Netherlands, the ACM – a proponent of leasing generally – does not see any reason in advance for considering leasing by operators to non-operators to be anti-competitive. However, it does not rule out that leasing agreements can be harmful to competition – for example, with long-term arrangements between operators where the competitive positions between them change, or if operators exchange business-sensitive information about their networks.



Mandated spectrum leasing in Europe

In contrast to preventing spectrum leasing, a growing list of markets (especially in Europe²⁵) are imposing requirements on mobile operators to lease bandwidth to industries. These are attached to the awards of 5G frequencies:

- Denmark – In the 3.5 GHz band, the 60 MHz block (at 3740–3800 MHz) acquired by TT-Netværk is subject to an obligation to lease locally to enterprises and public institutions for private networks (to be used exclusively for the needs of these enterprises and public institutions).
- Czechia – In the 3.4–3.6 GHz spectrum band, 20 MHz blocks won by O2 and CentroNet were attached to the obligation of leasing frequencies to support Industry 4.0.

Mandating leasing on operators to ensure the availability of spectrum for industries is envisaged for a number of upcoming 5G auctions. However, it can have negative impacts by diminishing the opportunity of voluntary, commercial leasing. This is especially the case where regulated prices are set at such a low level (or even below cost), removing any monetary gain for operators/primary users, discouraging them from participating in leasing in the open market. This may also cause a social detriment as it could lead to spectrum being sub-leased even if the ideal use lies elsewhere (such as being employed at a busy mobile network location).

4.2 Spectrum set-asides

Another risk to leasing stems from the approach to spectrum assignments that many regulatory agencies have considered – and in some cases determined to adopt – for frequencies earmarked for 5G use. Most authorities have continued to make spectrum available for 5G in traditional ways (i.e. by auctioning nationwide, exclusive 5G licences). However, some regulators have set aside a portion of spectrum in priority 5G bands (for example, ringfencing some of the 3.5 GHz range) for local users (e.g. businesses) so they can build their own private 5G networks. A set-aside is defined here as a portion of spectrum in a harmonised mobile band that is treated differently to the remainder of the band, which is treated more conventionally by being awarded through an established competitive process such as an auction.

Like mandated access, such alternative options to the traditional licensing mechanisms could stop leasing developing in a commercial competitive way, influencing how prominent it becomes in the 5G age. Set-asides have been controversial as there is a concern that the spectrum may go unused in many areas and means less spectrum is available for public 5G services. Logically, making spectrum available for industrial users via reservations reduces the amount available to other parties, specifically operators. The resultant scarcity is associated with higher lot prices being paid at auctions, which is linked to worse coverage, slower rollouts and lower broadband speeds of mobile networks.²⁶

²⁵ 5G spectrum for local industrial networks, Ericsson, 2021

²⁶ For more information, see: <https://www.gsma.com/spectrum/resources/effective-spectrum-pricing/>



CASE STUDY

Set-asides for verticals in Germany

Amid increasing appetite from sectors to deploy dedicated networks, some countries have begun to consider licensed spectrum as part of industrial digitisation and applications. Germany has moved earlier and further than many European counterparts, with lobbying and/or requests from verticals resulting in the allocation of locally licensed spectrum in the 3700–3800 MHz band range in 2019. However, reserving spectrum in a key 5G band for verticals drove higher prices. This was further compounded by the successful bid of a new-entrant operator (not subject to the minimum coverage obligations imposed on the three incumbent operators). This induced scarcity resulted in mobile operators paying €3.59 billion for 300 MHz of spectrum, equivalent to one of the highest \$/MHz/pop/year (PPP) in the region.²⁷ As of November 2021, BNetzA has granted 169 applications for the assignment of frequencies for local 5G networks, representing far fewer users than the millions that could be using this spectrum for public networks.²⁸

4.3 Technical considerations

A third challenge relates to technical matters or inputs needed to lease successfully. The feasibility of leasing depends on how much spectrum has been brought to the market to support advanced mobile technologies (e.g. 4G and 5G), as well as intensity of use, with demands for leases often materialising in congested areas, known as blackspots, where there may not be any residual spectrum available. A lack of spectrum for operators is a particular problem in several African markets but can be an issue anywhere, particularly when compounded by vertical reservations. The challenge in the 5G era is that the significant increases in number of applications and consumer data traffic mean there is less spectral capacity to lease out. The likely implication is that leasing becomes relatively more widespread in rural or suburban areas as spectrum in the C-band and above will be fully used in high-value urban centres.

Spectrum leasing is only possible if it is technically practical. However, leasing requests can risk being complicated to process

– for example, due to the requisite coordination with a mobile operator's own network deployment or incumbency issues that make a band complex to clear. A successful leasing scenario enables different users to operate effectively without interference and without a negative impact on the network performance of the lessor. Yet, parties in an agreement may need to ensure continuous monitoring of the leased channels and quality of packet transmission, which could require more intelligence to be incorporated into the operator's network.

In TDD bands, a challenge for leasing may be the synchronisation. In mid bands, all actors would in practice need to use the same synchronisation. One of the key reasons for local/vertical users to lease spectrum is that they are interested in having another uplink/downlink ratio, which may not be possible, even in adjacent bands. Consequently, leasing of spectrum needs sufficient investment and resources in terms of technical analysis to ensure coexistence for a licence that may impact the revenue profile.

²⁷ The Mobile Economy Europe 2021, GSMA, 2021

²⁸ Übersicht der Zuteilungsinhaber für Frequenzteilungen für lokale Frequenznutzungen im Frequenzbereich 3.700-3.800 MHz, BNetzA, 2021



4.4 Unattractive commercials

A fourth and fundamental obstacle to leasing originates from commercial challenges: the potential opportunity may not be sufficient to incentivise licence holders to engage. Typically, the foremost motivation of operators that have acquired an amount of spectrum is to put that asset into use in network deployments or upgrades (as quickly as possible). Where award outcomes have left spectrum holdings or networks less strong in certain areas, some operators (such as those in the US) have opted to engage in reciprocal sharing agreements or negotiated swaps to gain more contiguous blocks of spectrum, rather than agree leasing. The Dynamic Spectrum Alliance has also argued that primary licensees may not want to take on the transaction costs required to partition, disaggregate or sub-lease their licence to a third party, or may want to preserve optionality in the future to build out to less economically attractive areas.²⁹

For a primary licence holder that does want to lease spectrum within a certain part of its network, there are two contrasting economic implications: on the one hand, there is a monetary gain from the transaction; on the other hand, it incurs a cost due to reduced spatial coverage and possible interference in the leased region.³⁰ This trade-off presents as an optimisation problem, as leasing will not succeed unless incumbent users are motivated and willing to lease their spectrum in areas where it is underused and there is clear and commercially viable demand from other users.

In Finland, there have been no requests yet from the 'use it or lease it' requirement³¹ for C-band spectrum, while UK regulator Ofcom considers that there has been a general lack of demand for an extension of the leasing approach to other licences (i.e. mobile broadband). Consequently, what may well be the most significant barrier is the marginal business case. The costs of assessing commercial value, network set-up and integration, plus potentially unforeseen costs around coordination and transaction, issue resolution and interference management, are seen to outweigh relatively small potential revenues from low demand, making for an unattractive business opportunity.

Even where demand is present, there is also a challenge in establishing a price for a lease of spectrum that allows for cost recovery at least, especially in light of what is being charged by regulators directly to vertical users. The question is whether mobile operators are willing to lease at a price that verticals are willing to pay. The precedents set by some regulators to charge a very low price could undermine the business case for voluntary leasing by depressing the potential revenue opportunities, thereby inhibiting the development of a healthy leasing market. This may play into a lack of credibility around voluntary leasing, with operators perceived to have little incentive to be active in this secondary spectrum market, preferring to 'warehouse'. Even where spectrum is made available by the regulator specifically for local licences at low cost, strong interest is not guaranteed; in Finland, for example, most leases have been agreed for research purposes, with few commercial or industry uses.³²


²⁹ Comments to the FCC in the matter of portioning, disaggregation and leasing of spectrum, Dynamic Spectrum Alliance, 2019

³⁰ Pricing Strategies for Spectrum Lease in Secondary Markets, Al Daoud, Alanyali and Starobinski, 2010

³¹ The licence obligation that requires all operators to participate in tender organised by someone wishing to have a specific local service/lease.

³² <https://www.traficom.fi/en/communications/communications-networks/existing-radio-licenses-frequency-bands-2300-2320-mhz-and>

5. The enablers



Despite the barriers outlined, voluntary spectrum leasing is a nascent business that we could see grow and change, especially as the 5G era fully takes hold. The potential enabling factors to expand the market and realise the opportunity somewhat mirror the challenges identified.

5.1 Regulatory certainty

Regulation of mobile communications often grants limited property rights to licence holders of spectrum, with those licensees able to provide only a specific service and not to sell, trade or lease access to any part of their holdings. Many stakeholders have argued against such rigid regulations and

the resultant inefficiencies; some markets have made efforts to introduce reforms to encourage the development of spectrum secondary markets. The implementation of an appropriate regulatory framework for spectrum leasing is vital to realising that ambition.

The removal of barriers that have prevented or even forbidden leasing occurring to date should be the first port of call for regulatory bodies, so mobile operators can make spectrum across different bands accessible to other users, including competitors, for a given period of time and/or in a defined area. While many spectrum licences are granted for periods of 15–25 years, the telecoms market and technologies can undergo significant change during that time, with new or alternative actors able to make better use of the spectrum than the original licensee. Leasing can provide the flexibility to extract maximum efficiency from spectrum assets, which will benefit all concerned, including consumers.³³

Rules surrounding spectrum leasing should be clear in their definitions to avoid potential confusion or conflation with other forms of spectrum access, such as trading or pooling. For instance, the sharing of 800 MHz spectrum between

Magyar Telekom and Telenor in Hungary has been referred to as leasing, when in reality it more closely resembles a pooling arrangement.³⁴ While leasing should be based on voluntary commercial agreements, the right regulatory framework could support leasing and help overcome potential concerns around the implications for competition. This can be achieved by providing clarity with respect to several components, including considerations for the granting of permission to lease spectrum and the roles and responsibilities of the lessor and lessee when it comes to network coverage and rollout, and fees, as well as licence obligations relating to technological neutrality, quality of service and consumer protection.



CASE STUDY

Regulatory frameworks for spectrum leasing in the US

The US was a frontrunner in adopting policies and procedures to facilitate leasing. The FCC's 2003 Secondary Markets Order provided for two types of spectrum leasing arrangements intended to "promote more efficient, innovative, and dynamic use of the spectrum, expand the scope of available wireless services and devices, enhance economic opportunities for accessing spectrum, promote competition among terrestrial wireless service providers, and eliminate regulatory uncertainty surrounding terrestrial spectrum leasing arrangements".

Depending on the form of leasing (whether "spectrum manager" or "de facto"), the lessor may remain responsible for ensuring compliance with underlying licence requirements and need pre-approval from the FCC to enter into an agreement. In 2004, the FCC clarified that spectrum leasing may include "dynamic" arrangements, where the lessor and lessee share use of the same spectrum through the use of cognitive radio technologies. In doing so, it put confidence in the ability of the market to find innovative means of enhancing spectrum access and lowering costs.³⁵

³³ Spectrum Leasing (Consultation 17/47s): Submissions Document, ComReg, 2017

³⁴ "Customers in Hungary to benefit from 4G network sharing between Magyar Telekom and Telenor", Telenor, February 2015

³⁵ Spectrum Trading in the EU and the US - Shifting Ends and Means, Squire Sanders, 2011

5.2 Spectrum access

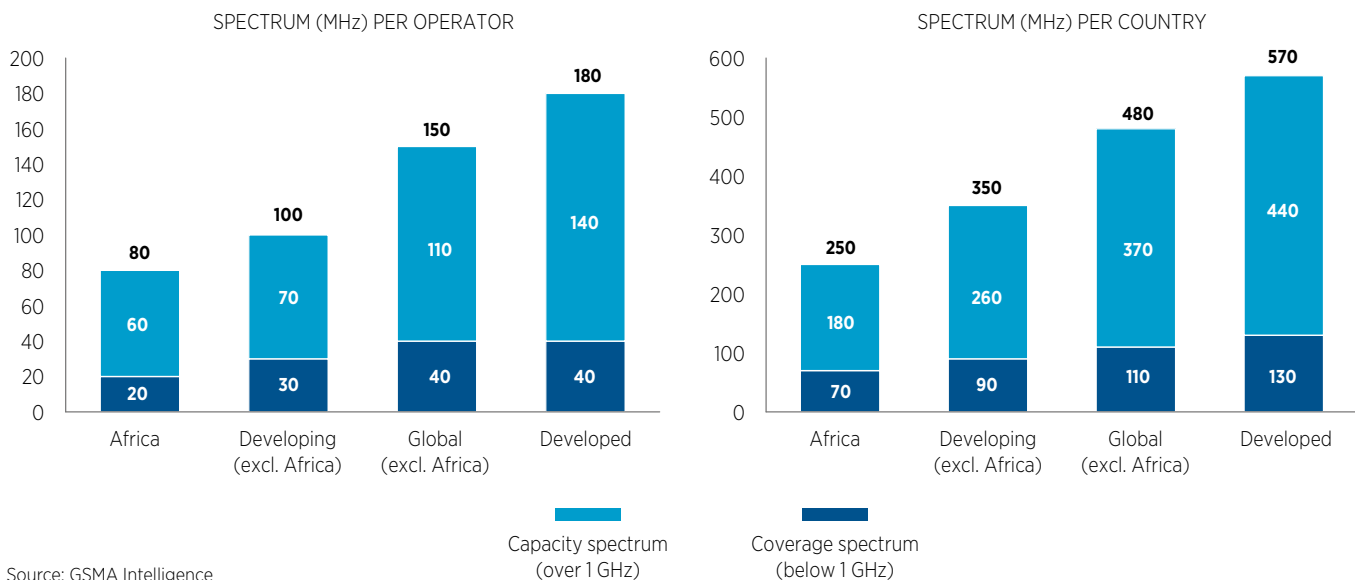
The continued growth of mobile networks and services depends on the availability of sufficient spectrum resources in harmonised bands. In addition to establishing an appropriate regulatory framework, resolving spectrum scarcity is a pre-condition for leasing; otherwise, it cannot be a viable option for primary licence holders, such as operators, and for the market as a whole. In

Africa, for example, the amount of licenced spectrum in the last decade has fallen way behind other regions on a per-operator and per-country basis. Governments in the region have on average assigned approximately half the amount of spectrum of the global average.³⁶

FIGURE 5

AVERAGE SPECTRUM ASSIGNMENTS, 2019

Spectrum assignments below 3.7 GHz and excluding 5G-specific licences



Source: GSMA Intelligence

The speed, reach and quality of 5G networks and services depend on governments and regulators supporting timely access to the right amount and type of affordable spectrum, under the right conditions. For initial launches, regulators should make available 80-100 MHz of contiguous spectrum per operator in prime 5G mid-bands (e.g. 3.5 GHz) and around 1 GHz per operator in high bands (e.g. mmWave spectrum). GSMA analysis shows that a total of 2 GHz of mid-band spectrum, on average, will be required to support the growth of 5G during the 2025-2030 timeframe.³⁷ This is the average amount needed to guarantee the IMT-2020 requirements for 5G, in turn an enabling factor to spectrum leasing. In addition to access, transparency around spectrum renewal, underpinned by a forward-looking roadmap from the regulator, will be important to ensure certainty for market participants.

Guaranteeing spectrum supply and licence renewal is a key tool to creating a liquid secondary market for leasing, which can provide an explicit solution to meet vertical demand and presents a practicable alternative to set-asides. Some regulators have adopted a 'use it or lease it' approach, with licence conditions and obligations designed to incentivise operators to utilise their spectrum or make it available to others where it will not be deployed or not used within a reasonable timeframe. 700 MHz is another priority 5G band which may be of interest to prospective lessees – particularly those in rural areas or those operating extensive logistics and sensor networks – given its propagation characteristics for supporting wide-area and in-building coverage. Though some assignments were beset by delays due to the pandemic, momentum in awards of 700 MHz spectrum will build – particularly in Europe, where several EU member states are catching up having missed the European Commission's December 2020 auction deadline.³⁸

³⁶ Effective Spectrum Pricing in Africa: How successful awards can help drive mobile connectivity, GSMA, 2020

³⁷ Vision 2030: Insights for Mid-band Spectrum Needs, GSMA, 2021

³⁸ Spectrum Navigator, Q2 2021: new insights and trends to watch, GSMA Intelligence, 2021

5.3 A positive business case

With those foundational pillars of spectrum leasing in place, a further enabler is the business case. Though evidence can often be lacking even where leasing is allowed, the potential to create a positive commercial agreement can provide incentives for market participation when there is demand. The mobile virtual network operator (MVNO) market may provide a useful case in point. Here, a virtual player does not have its own spectrum licence but rents capacity and often other radio elements from a host operator to provide retail mobile services. An MVNO market worth \$61.9 billion in 2020³⁹ suggests that MVNOs can be valuable partners for operators. The MVNO market has typically been allowed to grow freely and often without access regulation imposed on operators, which may suggest learnings for how to expand the spectrum leasing market.

On the whole, operators are pro-leasing, provided it is on a voluntary and commercial basis. A decision whether or not to support a new leasing request will depend on proposed conditions and payment terms presented by a potential lessee, as well as internal discussions, including around the resources and costs involved in servicing the agreement. Regulators have a key

role to play in lowering the costs for lessors, ensuring leasing is an appropriate mechanism to provide shorter term and relatively quick access to spectrum. However, considering a longer-term view can also be crucial to enabling a positive business case. In larger markets or those with strict coverage obligations, leasing with build-out requirements can support the cost-benefit assessment, with revenue generation not a major motivating factor. Agreements based on geographical coverage and not just population coverage can incentivise engagement and deliver mobile services to rural and less densely populated locations.

From a prospective lessee's standpoint, a positive business case is equally important, with low administration fees a means of enabling that to materialise. While less than buying the spectrum asset, transaction costs fall disproportionately on smaller or rural users who would have to "incur spectrum leasing costs that are likely to be higher for them than for a large national operator who is likely to already have an in-house team to manage spectrum transactions."⁴⁰ Regulators can again play a supportive role by ensuring a low burden for applicants in terms of time, effort and cost.



CASE STUDY

AT&T in the US

AT&T leases spectrum to specific third-party partners, with the overall process for the execution of leases bound by tight rules administered by the FCC. It defines six types of lease:

- commercial leases for revenue purposes
- licence protect, where AT&T leases to a third party to build so AT&T can meet licence obligations when no internal build is planned
- lease to build in order to complete coverage, with roaming revenue as compensation in areas where no build is planned
- contraband interdiction system (CIS) around prisons to comply with regulatory requirements
- short-term transaction-based leases filed/cancelled as needed to use new spectrum from a transaction or swap prior to licence transfer approval by the FCC
- leases to utilities for smart grid build-outs.

Like many operators, AT&T often acquires spectrum on a national basis, which it aims to put to use as soon as possible. While spectrum leasing is growing at pace, commercial leasing accounts for a minority of cases. Sometimes AT&T will lease spectrum for a nominal amount to small, regional telcos that AT&T can help to build out their networks (typically in rural areas); in return, AT&T customers can roam onto those networks. When compared to the cost of rolling out a network itself, such partnership models can point to a positive business case for AT&T to engage in leasing.

³⁹ Source: Mordor Intelligence

⁴⁰ Analysis of Proposed Modification to CBRS PAL Framework, Lehr, 2017

5.4 Negotiation between parties

An enabling policy environment provides a private route for spectrum rights to flow to higher-value users and gives the freedom for parties to explore spectrum opportunities and negotiate access deals freely and in good faith, with limited or no regulatory involvement. For instance, the ACM sees a possible role for it and the Netherlands Radiocommunications Agency to guide the market and support commercial negotiations, giving participants the freedom to agree deals between themselves, instead of drawing up rules in advance.

Agency to enter into a contract could therefore be a further enabler to advancing spectrum leasing. It represents a market-based framework that allows parties to determine the value of a given portion of spectrum and could ensure the efficient and flexible use of finite assets. In specific cases where regulatory intervention may be required, a simplified, streamlined approval system for leases could enable agreements, while a database to effectively keep track of locations of licensors and potential risk of

interference could facilitate discussions between parties. Where authorities determine to use ex-ante competition assessments to conduct checks and balances over proposed transactions, they should be timely – particularly for reasonably straightforward leases⁴¹ – to minimise the burden on industry players and avoid erecting artificial barriers to leasing agreements.

In certain circumstances, commercial negotiation could allow for the emergence of a spot market (similar to wholesale electricity markets⁴²) run by spectrum brokers or an exchange mechanism, which would identify available spectrum assets from operators, manage them at particular locations and determine allocations to lessees. The allocation could be determined through a bid auction, or the broker could announce a set of prices for the available spectrum assets and adjust the prices over time to maximise expected revenue or to clear the market periodically. The choice of mechanism – and in turn the efficiency and revenue gains – would be influenced by the level of market demand.⁴³

⁴¹ For example, the leasing of small quantities of spectrum, or the leasing of spectrum in a small number of discrete locations or by small operators.

⁴² An Open Access Wireless Market: Supporting Competition, Public Safety, and Universal Service, Cranton and Doyle, 2016

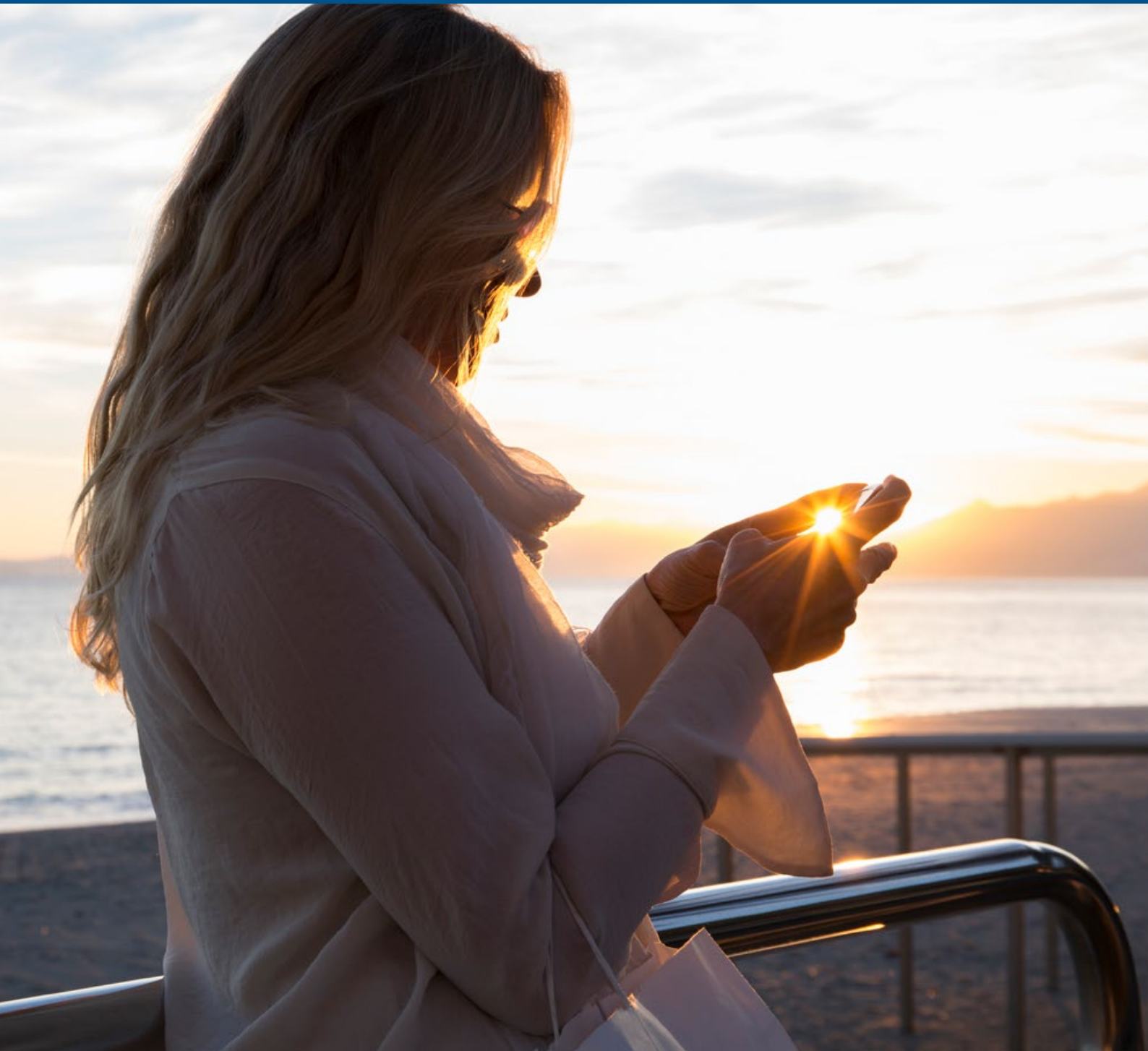
⁴³ Spectrum Markets: Motivation, Challenges, and Implications, Berry, Honig and Vohra, 2010



CASE STUDY

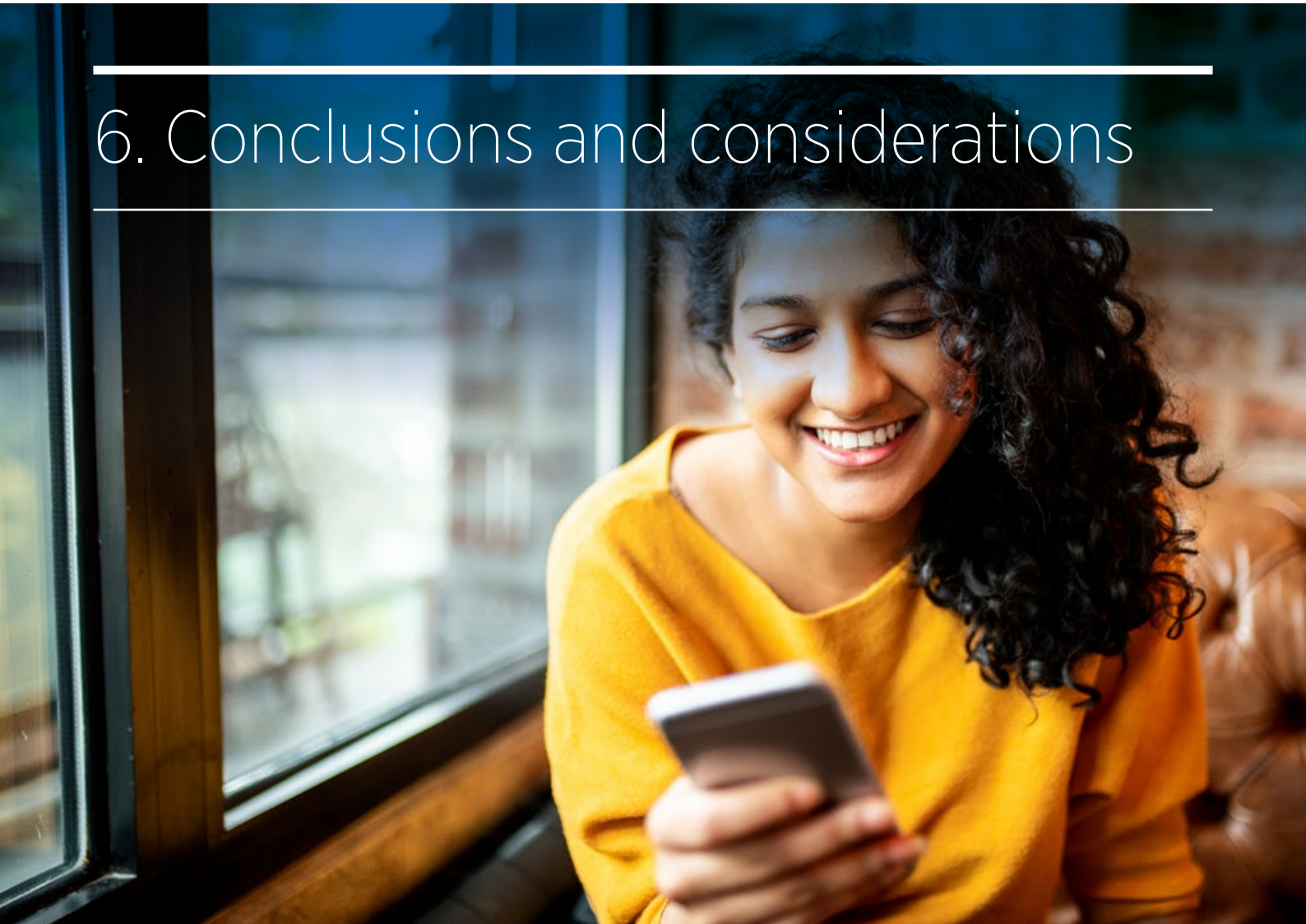
Federated Wireless, US

Federated Wireless has announced the availability of its Spectrum Exchange, which – upon final approval by the FCC – will allow Citizens Broadband Radio Service (CBRS) licence holders to lease their spectrum, when not in use or not yet put into use, to third parties. The exchange is an automated portal that will provide near-instant access to spectrum at targeted locations without interaction directly with the regulator.⁴⁴ Market exchanges can be a tool to strengthen incentives for secondary market transactions, while overcoming administrative burdens to leasing and ensuring spectrum does not remain idle.



44 "Federated close to launching 'Airbnb' for CBRS spectrum exchange", Fierce Wireless, October 2021

6. Conclusions and considerations



Despite certain prevailing challenges, our analysis points to a clear market opportunity for spectrum leasing, with potential benefits irrespective of the type of lessee. There is strong consensus that it should be permitted on a voluntary and commercial basis, rather than imposed by regulators. Several operators also believe 5G could drive leasing forward due to greater spectrum supply (e.g. in mid and high bands), as well as demand from industries (for example, manufacturing, ports and utilities) and other telcos.

However, in dense and congested areas, rising consumer data traffic means there is less spectral capacity to lease out. A further barrier is a marginal business case, with the costs of assessing commercial value, network set-up and integration, and interference management sometimes seen as outweighing the potential revenue gain. That said, leasing is a nascent business

that could experience change – particularly with favourable regulatory decisions and the right steps taken by operators to mitigate the risks and accentuate the benefits of spectrum leasing. To that end, below we outline considerations for stakeholders to support leasing's potential, which may lead to more detailed analyses of revenues and costs in the future.

Considerations for policymakers

Establish an enabling regulatory environment

As we move further into the 5G era, with a shift in focus from maximum coverage for voice services to targeted coverage for various kinds of data services, regulators should consider permitting voluntary spectrum leasing, whether between a mobile operator and another operator, vertical users using the same or a different mobile technology generation, or other users looking for different types of technologies. Commercial negotiations should be allowed to determine the responsibilities of relevant parties with respect to network coverage and rollout, fees and more. Within this environment, the prospect of arranging a lease will be helped by lower costs, particularly on the lessee side. Specifically, transaction costs to acquire access to spectrum in small geographic areas in less densely populated locations should not be higher than the value of the spectrum to be leased or sold.

Encourage voluntary commercial negotiation

Spectrum leasing is a dynamic spectrum access technique in which lessors and lessees form a partnership for mutual benefit. With no one-size-fits-all model for leasing, an approach centred on commercial negotiation aids price discovery and helps maximise the benefits and efficient use of exclusively licensed spectrum, while also ensuring it is available to meet the needs of other potential users. In certain situations, competition law reviews could provide for a useful safeguard mechanism but should be as burdenless and quick as possible so as not to inhibit competition or innovation, or limit the prospect of voluntary agreements being reached.

Bring sufficient spectrum to market

Although the best option for spectrum leasing will depend on local conditions, a precondition for the practice at all is bringing a sufficient amount of spectrum to market to support advanced mobile technologies (e.g. 4G and 5G). GSMA Intelligence research suggests some markets have fallen well behind others in terms of the volume licensed over the past decade. Regulators should consider taking steps that enable mobile operators to make meaningful amounts of spectrum available to rural providers or non-traditional spectrum users, such as industrial or enterprise customers.

Favour leasing as a more efficient alternative to spectrum set-asides

Spectrum carve-outs for vertical industries are causing a barrier to meeting growing data demand in some cases, and should be avoided in priority 5G bands. Sharing and leasing are typically better options in these situations. Policymakers should consider assigning mobile spectrum as usual and, where needed, create licence terms and conditions to help meet the needs of verticals. If necessary, a 'use it or lease it' approach can incentivise operators either to utilise their spectrum or make it available to others where it will not be deployed or used within a reasonable timeframe.

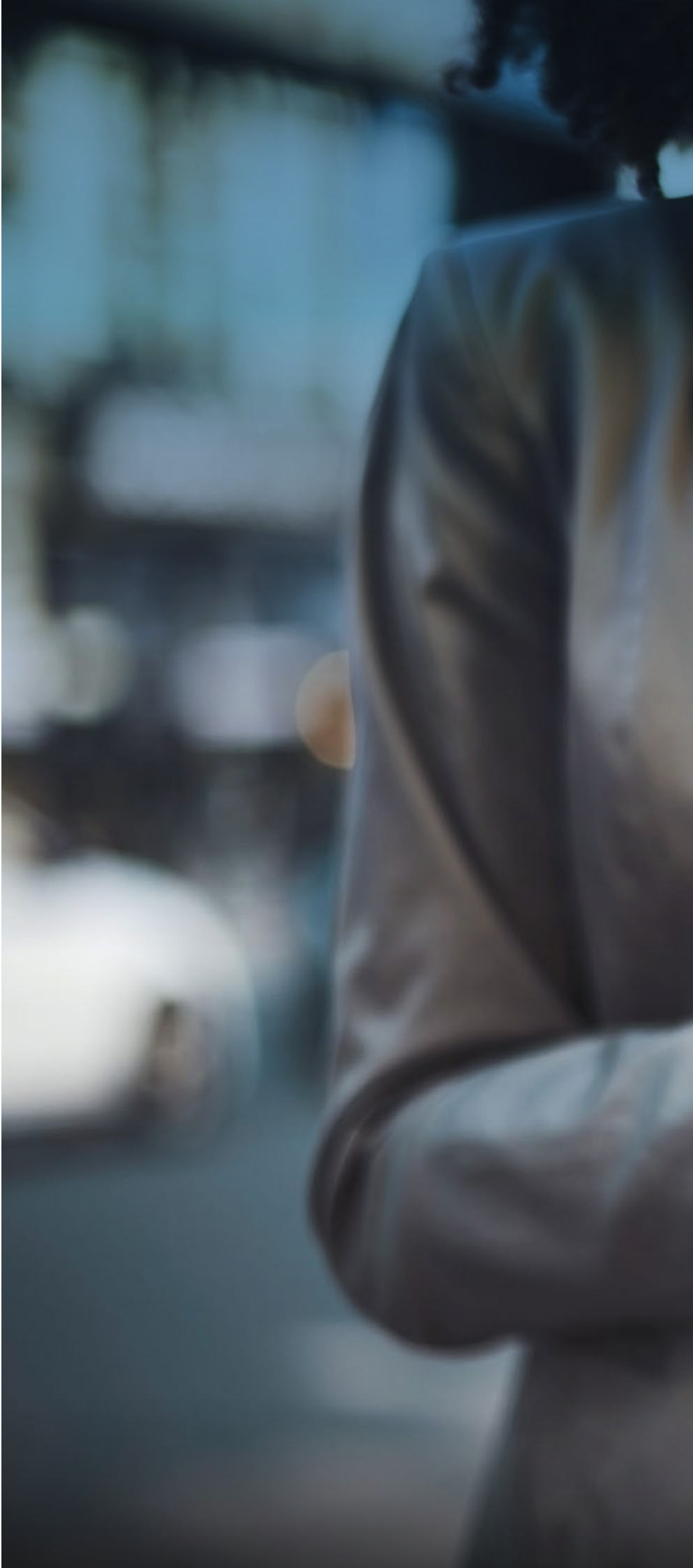
Considerations for market players

Determine the strategy and business case

In light of the opportunities discussed, mobile operators and other organisations should consider identifying the situations where they can take advantage of spectrum policy to engage in the secondary access market. The choice between transfer and lease will depend on circumstances and preferences, and is for them to decide, but operators should position themselves to be able to realise the potential monetary returns. In the 5G era, there may be a stronger business case for leasing to industries for dedicated, high-performance connectivity, while real-world examples suggest leasing to smaller operators can support rural rollouts where economic viability is uncertain.

Organise internal operations in support of leasing

Making spectrum leasing a success may require mobile operators to create a cross-functional team comprising various skillsets to understand the needs of the market and explore opportunities, while managing risks. Commercial departments should work with network-focused colleagues to overcome technical hurdles, including interference or band clearance issues, to establish commercial agreements.



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